REVIEW

Dyspraxia or developmental coordination disorder? Unravelling the enigma

John Gibbs, Jeanette Appleton, Richard Appleton

Arch Dis Child 2007;**92**:534–539. doi: 10.1136/adc.2005.088054

Dyspraxia is an enigma to many people, both professional and lay alike—what is it, how does it relate to developmental coordination disorder and associated conditions, how common is it, how is it recognised and diagnosed and how should it be managed? This article attempts to unravel this enigma by: dealing with the terminology of coordination difficulties from the ''clumsy child syndrome'' through ''dyspraxia'' to ''developmental coordination disorder (DCD)''; briefly examining the debate as to whether dyspraxia or DCD should be regarded as a medical or social disorder; discussing the differential diagnosis of dyspraxia or DCD; considering the assessment of children with dyspraxia or DCD; reviewing the range of current treatment approaches in the UK.

Dyspraxia has been defined as ''a breakdown of praxis [action]'' and ''the inability to utilise voluntary motor abilities effectively in all aspects of life from play to structured skilled tasks'' (Chu S and Milloy NR cited in Bowens and Smith).[1] An alternative, psychology-based definition is ''motor difficulties caused by perceptual problems, especially visual-motor and kinaesthetic motor difficulties''.[2] Within the medical and scientific communities dyspraxia is generally considered to mean an impairment of, or difficulties with, the organisation, planning and execution of physical movement with a developmental rather than acquired origin. Most individuals with dyspraxia manifest a combination of both ideational or planning dyspraxia and ideomotor or executive dyspraxia; ideational or planning dyspraxia affects the planning and coordination, and ideomotor or executive dyspraxia affects the fluency and speed of motor activities.

Clearly, in the performance of everyday physical activities, there will be a spectrum of ''normality'' and some children with dyspraxia may lie at one end of the normal spectrum. Determining what constitutes ''normal'' may be difficult. One criterion that may be used to determine whether the child's motor skills fall outside the spectrum or range of normality is whether the difficulties have any functional effect and intrude on school and leisure activities. Unfortunately, this may prove difficult because a child's functional abilities may be interpreted differently depending on their family background, culture and expectations—as well as the expectations of their school and peer group, so that two children with the same profile of motor difficulties may be labelled differently. This raises the issue as to whether there may be an inappropriate medicalisation of the child who is simply at one end of the normal distribution and this has led to a suggestion that dyspraxia could be regarded more as a social disorder rather than medical condition.[3] The term is being increasingly used by health and educational professionals to label a child's awkwardness or clumsiness and, in part, this is media-driven. Consequently, dyspraxia is likely to be regarded as a medical rather than social disorder, although it should be considered a descriptive term for a syndrome, in a similar way to the term ''cerebral palsy'', rather than a specific medical diagnosis. It is often used as a catch-all term to describe symptoms of poor coordination, clumsiness or awkwardness, and as such has the potential for not considering the possibility that the child's difficulties in planning and executing physical actions may be due to a definite neurological (or other physical) condition. This will be discussed later.

Although there is broad agreement that dyspraxia involves a disorder of movement coordination, there is no consensus on a more precise definition. The inaugural UK interdisciplinary forum on dyspraxia in 1994 was unable to identify a definition that was acceptable to all represented disciplines,[4] although two suggestions were offered:

> In the absence of any known neurological condition or intellectual impairment, dyspraxia is the inability to plan, organise and coordinate movement. It results in fine and gross motor problems and/or speech difficulties.

or

> Dyspraxic children are those, who in the absence of physical and/or neurological disorder, have difficulties in control and coordination of voluntary motor activity. The condition is developmental rather than acquired. (Brown D, cited in Bowens and Smith 1999)[1]

The difficulty in defining dyspraxia has been compounded by the varying terminologies used over the years to describe children with coordination difficulties. The background of the different professionals who see these children, and their

See end of article for authors' affiliations

Correspondence to: Dr J Gibbs, Department of Paediatrics, Countess of Chester Hospital, Liverpool Road, Chester CH2 1BQ, UK; john.gibbs@coch.nhs.uk

Accepted 27 November 2006

Abbreviations: DAMP, disorder of attention and motor perception; DCD, developmental coordination disorder; MBD, minimal brain dysfunction

experience and familiarity with the condition, has influenced terminology. The terms most commonly used have been:

- clumsiness or the clumsy child syndrome
- minimal brain dysfunction (MBD)
- developmental apraxia
- perceptuomotor dysfunction
- motor learning difficulty
- sensory integration disorder
- disorder of attention and motor perception (DAMP)
- developmental coordination disorder (DCD)

Clumsiness, or clumsy child syndrome, should be avoided because of its perceived pejorative connotations.[5] If clumsiness, and the clumsy child syndrome, is restricted to those with developmental coordination difficulties without an underlying neurological disorder, then this becomes synonymous with dyspraxia.[6 7] The term ''clumsy child syndrome'' is still in general usage in the USA.[8]

MBD was the term introduced to ascribe a pathogenesis for hyperactivity, with or without additional problems such as impaired coordination and specific learning difficulties, in individuals without an identifiable neurological disorder.[9] This was subsequently modified to brain ''dysfunction'' after it was accepted that the problems manifest by children with MBD did not necessarily result from damage[10]; however, the term remains misleading because the resulting functional disturbance may be far from minimal. Consequently, the term should no longer be used.

Developmental apraxia is indistinguishable from dyspraxia, while perceptuomotor dysfunction and motor learning difficulty are also essentially the same as dyspraxia. Coordinated movement depends on integrating sensory information and difficulties in this area may be prominent in some of those with dyspraxia.[11] Identifying sensory integration difficulties helps to guide treatment and offers an explanation for dyspraxia, but is not a specific diagnosis.

Children and adolescents with dyspraxia may have difficulties with behaviour or learning (eg, dyslexia), but these should be regarded as comorbidities rather than being an integral part of dyspraxia. Over half of children with coordination difficulties also have attention problems and these combined problems may be sufficiently pervasive to justify recognising a disorder comprising deficits in attention, motor control and perception (DAMP).[12 13] Other behavioural problems are also commonly seen in those with DAMP, and there are overlaps with oppositional defiant disorder and even autistic spectrum disorder. Although the concept of DAMP is useful, the acronym is a very unfortunate one, especially when applied to patients who tend to have fairly low self-esteem. The authors would urge that an alternative term, such as DCD ''plus'', is used instead of DAMP.

DCD is a term preferred by many allied health professionals to describe children with coordination problems that are developmental in origin. The American Psychiatric Association considers that DCD should be diagnosed only if the following four diagnostic components are present[14]

- Motor coordination during daily activities should be substantially below that expected for age and intelligence.
- Resulting motor difficulties interfere with academic achievement or activities of daily living.
- The coordination problems are not due to a general medical condition (eg, cerebral palsy or muscular dystrophy) or a pervasive developmental disorder.
- If mental retardation is present, the motor difficulties are in excess of those usually associated with mental retardation.

In reality, the definition of DCD is very similar to dyspraxia. A survey of health and educational professionals showed widespread uncertainty about the definitions of, and distinction between, DCD and dyspraxia.[15] Furthermore, the rationale for using one or the other term in the literature has been unclear.[16] Therefore, DCD and dyspraxia should be regarded as synonymous. It is clearly helpful for professionals and parents to adopt a single term when describing these children to avoid confusion and to facilitate a consistent understanding of approaches to management and research. A consensus is developing in favour of the term DCD, although a recent systematic search found that a variety of other terms were used to describe developmental motor coordination difficulties in nearly 50% of studies.[17]

There is an argument for avoiding labels and instead providing a brief, practical description of a child's coordination difficulties together with any comorbid problems. However, despite their limitations, labels can be helpful in summarising problems, communicating these to families or professionals and in planning services. Importantly, labels should always be supplemented by a more complete description of a child's problems. In summary, it would seem helpful for clinicians to adopt a term that is understandable by parents and children alike. The authors' preference is for DCD over dyspraxia and this term will now be used throughout this paper. If there are associated problems of attention control, we would recommend a diagnosis of DAMP (although, preferably, this unfortunate and insensitive acronym, DAMP, should be replaced by the term DCD ''plus'').

PREVALENCE

DCD has been referred to as a ''hidden problem'' with an estimated prevalence as high as 10%.[18] A figure of 6% is more likely,[6 19] being severe in 2%; a further 10% have the condition at a milder level, which implies that most school classes will have at least one affected child. It is reported to affect males four times as frequently as females.[20] Children born prematurely[1] and children with extremely low birth weights[21] are at a significantly increased risk of demonstrating DCD.

PRESENTATION

DCD is manifest functionally by difficulties in all aspects of daily living. In the preschool child, common features reported by parents include a history of delayed developmental milestones, particularly crawling, walking and speech, difficulty with dressing, poor ball skills, immature art work and difficulty making friends. Approximately 25% of children with DCD will be referred before starting school. Parents who have a specific list of concerns, and those parents in higher social classes, are more likely to express their concerns and secure an assessment of their child.[5] The remaining 75% will be referred during the first few years in primary school. Presentation at this age includes persistence of (and no improvement in) the problems noted in the preschool years, such as slow, immature and laborious handwriting and difficulties in copying from the blackboard. Consequently, there will often be a considerable delay before these children are referred for specialist advice. They may have shown some delay in achieving developmental milestones, specifically in gross motor and speech/language skills, although others may simply have been irritable or ''difficult'' children. Occasionally, parents will merely have expressed that ''something was not quite right'', without being able to be more specific. In all of these situations, the child may or may not have been brought to the attention of their health visitor or general practitioner. Alternatively, the parents may have been told not to ''worry'' and to simply ''wait and see'', again resulting in a delay for specialist advice.

MANAGEMENT

The management of children with DCD must begin with an accurate diagnosis. The two principal questions to be answered when assessing a patient with possible DCD are, first, is there an underlying neurological or physical disorder and, second, does the patient have significant coordination difficulties compatible with DCD? Paediatricians and paediatric neurologists are likely to feel more comfortable attempting to answer the first rather than the second question owing to unfamiliarity with the normal variation in motor skills throughout childhood and the formal testing of these skills. An underlying neurological or medical disorder must always be considered and excluded, as emphasised in the UK forum on dyspraxia in 1994[4] and by the American Psychiatric Association.[14] Box 1 shows the neurological/medical conditions that the authors have identified in children referred with either a new or long-standing ''diagnosis'' of ''dyspraxia'' (this is unlikely to be exhaustive). Where a specific neurological or other medical disorder is identified, it would be inappropriate to persist with the term DCD.

History

The history of a child or young person with DCD is outlined in the Presentation section. Coordination difficulties of late onset and, certainly, any loss of acquired or existing motor skills would not be consistent with DCD and would suggest an underlying neurological (or other medical) disorder.[22] A history suggesting new-onset motor difficulties or regression needs to be interpreted carefully. This might reflect the fact that pre-existing motor difficulties may have been mild, and only become manifest and recognised when a child starts school or with the increasing demands of the school curriculum as the child progresses through the school. Motor difficulties may even appear to increase with time since a fixed relative deficiency (eg, performing at half the age level expected) results in a widening absolute gap over time. Conversely, motor coordination problems may appear to be less of a daily difficulty during the secondary school years if the child is able to withdraw from those activities (including games and sports) which cause difficulty and stigmatisation. However, cognitive and behaviour problems may become more obvious because of frustration with poor motor skills, low self-esteem and social isolation.

A history of possible epileptic seizures or a sensory disturbance (specifically, a significant visual or hearing deficit) must be sought as a possible cause for impaired coordination.

Box 1 Neurological disorders initially diagnosed as ''DCD/dyspraxia''

Peripheral neuromuscular conditions

- Becker muscular dystrophy
- myotonic dystrophy
- hereditary motor and sensory neuropathy (HMSN) types Ia and II
- myotonia congenita (autosomal recessive)
- congenital myasthenia

Central nervous system conditions

- cerebral palsy (with a recognised antenatal or perinatal aetiology; the children have usually been mildly affected with predominantly hemiplegic or mixed (athetoid or ataxic) features)
- brain tumour (slow growing in the posterior fossa)
- panthotenate kinase-associated neurodegeneration (Hallervorden–Spatz disease)
- perisylvian (opercular) syndrome
- benign familial chorea
- epilepsy
  - absences with myoclonia
  - myoclonic-astatic epilepsy
  - Landau–Kleffner syndrome

Mixed peripheral and central nervous system conditions

- Friedreich's ataxia
- Pelizaeus–Merzbacher disease

Miscellaneous

- Ehlers–Danlos syndrome
- GM1 gangliosidosis (juvenile onset)

Examination

A careful neurological examination should search for signs of a peripheral neuromuscular, cerebellar, other central neurological or connective tissue disorder (box 1) and the examination must include assessments of both hearing and vision. Coordination can be assessed using the motor skill subsections of standard developmental assessment schedules. Other schemes which have been developed are particularly useful for assessing motor coordination,[23 24] including the Bruininks–Oseretsky Test of Motor Proficiency; the short form of this test takes 30 min to administer compared with the 2 h full version.[25] The most widely used assessment of motor skills in the UK is probably the Movement Assessment Battery for Children.[26] However, these motor assessments are likely to be more familiar to paediatric therapists than paediatricians, including neurodevelopmental paediatricians.

Further assessment

The paediatrician (hospital and community) or paediatric neurologist is likely to turn to the physiotherapist and occupational therapist to help in the diagnosis of DCD, and also to involve educational, clinical or neuropsychologists in the assessment of associated difficulties. Unfortunately, these professionals are in limited supply and while their contribution may be invaluable in those with DCD, paediatricians and paediatric neurologists have a clear responsibility for deciding which children need to be referred for such assessments. It is not appropriate to refer every child who is reported to be ''clumsy'' or ''awkward'' and, historically, too many children suspected of having DCD have been referred to occupational therapists when their motor skills are actually within the normal range.[16] Consequently, many referrals to occupational therapists are inappropriate, representing a considerable waste of resources and a clear illustration of one of the inefficiencies within the National Health Service.[27] A recent survey of 134 paediatric occupational therapists in the UK showed that children with DCD comprised 30.4% of the total caseload of children receiving occupational therapy services, but 61.7% of the total number of children who were waiting for assessment.[28]

Rather than expecting occupational therapists and physiotherapists to assess all those with suspected coordination difficulties, a useful approach is to seek information from health visitors, nursery or primary school staff. It is important to identify those more severely affected children who exhibit significant coordination difficulties in the late preschool and early school years to enable referral to occupational or

physiotherapy for further assessment and therapy. Those less-severely affected tend to present at a later age and can often be identified and managed without the need for referral to scarce and overstretched occupational and physiotherapy services.

School doctors (school medical officers) are ideally placed to assist in identifying school-age children and should be encouraged to undertake the assessment of children with suspected DCD. Also, when considering these children's motor performance, information should be sought from school staff on whether the child has attention-control problems or any generalised or specific learning difficulties, and also how the children relate to and mix with their peers. A report from any educational psychologist already involved with a child is extremely helpful. Most children being assessed for coordination difficulties probably will not be supported by an educational psychologist, but the assessment may indicate the need for such support in some of these children.

Portwood has produced a screening instrument, the Motor Skills Screening Test, which is appropriate for teachers to use and takes approximately 20 min to administer. The educational psychologist can augment this screening test with the more formal, and longer, Weschler Intelligence Scale for Children-Revised and, in conjunction with the developmental background, will be able to advise and support the child in the classroom setting. Preliminary data have certainly suggested that teacher and parental intervention may help some children with DCD.[29]

Standardised questionnaires could be used, such as the Perceived Efficacy and Goal Setting System tool which includes a care giver and teacher questionnaire.[30 31] A child's right to express its views is enshrined in the United Nations Convention on the Rights of the Child,[32] and attempts are being made by clinicians to include the views of the child with coordination difficulties.[33] Research indicates that using tools such as the Perceived Efficacy and Goal Setting System,[34] which assesses quality of life issues, enables the child to express its concerns regarding the effect of coordination difficulties on self-care and leisure activities. This is in contrast with the focus of parents and teachers, which tends to be on academic performance.[33] A 17-item questionnaire has been developed to identify young children with DCD. Although it performs well in children suspected of having this condition, it is not sensitive in detecting cases when applied to a general paediatric population.[35]

The initial assessment, supplemented by school reports, should have identified any coordination difficulties and their effect, as well as the presence of learning difficulties, attention-control problems and abnormal neurological signs. Relevant investigations need to be undertaken if there are abnormal neurological signs or definite regression, and subsequent management will depend on the identification of any specific diagnosis. In those with DCD, poor coordination and mild hypotonia may be the only signs and investigations will be unnecessary.

The assessment may indicate that the functional effect of coordination difficulties is minor compared with any associated attention deficits, learning difficulties or behaviour problems. These other problems should be managed primarily unless the poor coordination is causing particular concern to the child or young person. Referral should be made to occupational and physiotherapy for further assessment and treatment when coordination difficulties are having a significant functional effect. Occupational therapists and physiotherapists should also be involved when there is uncertainty over the effect of coordination difficulties. Additional help will be required if there are appreciable coexisting behavioural or learning problems.

Therapeutic interventions

There are very few well-designed trials of therapy in DCD.[36] In general, therapists use two main methods of treatment: task orientated and process orientated. The task-orientated approach aims to improve specific tasks through practice. Process-orientated therapy concentrates on developing sensory modalities involved in motor performance, such as the sensory integration approach,[37] or kinaesthetic (movement perception) training.[38] One of the few studies limited to the task-orientated approach showed significant improvements in motor skills, but only in those tasks that were specifically targeted.[39] The reported benefit of process-orientated therapy has varied, being similar to a general stimulation programme,[40] or superior to alternative treatments.[41]

More recently, other approaches have focused on improving aspects of self-esteem rather than the core problems of coordination,[42] and some clinics offer transitional programmes to help children meet the increasing educational and physical demands when moving from primary to secondary education. Although children with DCD generally benefit from physical therapies, many will probably obtain as much benefit from psychological support, perhaps in groups, to help them cope with their motor impairment and loss of self-esteem and develop compensatory strategies.

Few UK therapists are fully trained in the assessment and treatment approach of sensory integration. Therapists with considerable expertise in this area use a range of non-standardised activities to assess the child's level of ability in areas including motor skills, cerebral integration, limb girdle stability, body awareness and kinaesthetic awareness.

Children and adolescents with coordination difficulties clearly appreciate receiving appropriate treatment, and searching for help can be extremely frustrating for families.[43 44] Children with DCD can experience considerable difficulties at school and it is therefore important to educate the educators about this condition. Paediatric physiotherapists and occupational therapists, supported by the school medical and nursing services, need to improve general awareness and support in the schools for children with DCD to ameliorate some of the adverse medium-term and long-term psychological and social consequences of this condition.[45]

Outcomes

Early diagnosis, treatment and educational support are important. Failure to diagnose and address the motor and other commonly associated (comorbid) features seen in children with DCD may have major consequences in adult life, including unemployment, psychiatric disorders, substance misuse, poor interpersonal skills and criminality.[46 47] Longitudinal studies have shown deficits in motor skills persisting into adolescence and adulthood.[48 49] Other studies have investigated the link between DCD and the avoidance of physical activity. By addressing issues of self-esteem and self-efficacy towards physical activity, children have been encouraged to understand and accept their limitations. These strategies help such children to manage and cope with a problem that will persist into adult life.[50] Importantly, early intervention may enable the child to overcome some of the difficulties or to adopt strategies that make them manageable. Improvements in the organisation and execution of motor activities may have a secondary beneficial effect on body image, self-esteem and increased participation in the community.

CONCLUSION

The terminology of coordination disorders has been confused, but in practice dyspraxia and DCD should be regarded as synonymous; DCD is the authors' preferred term. DCD should only be diagnosed once an underlying neurological disorder has

been considered and excluded—and in the presence of non-progressive coordination difficulties arising in early life and falling distinctly outside the age-related norms using appropriate assessments.

It is not feasible to involve occupational therapists or physiotherapists in the assessment of all children suspected of having coordination difficulties. Occupational therapists are particularly scarce and, in some areas, non-existent. Information from school staff regarding a child's motor performance, supplemented by a careful examination by the school doctor or other paediatrician, should identify those children with DCD. Some of these children will need referral for formal occupational and physiotherapy assessment if there is uncertainty over the diagnosis or for support if their functional impairments are relatively severe. The predominantly education-based programme for addressing the problems of children with dyspraxia in Durham[45] points to an alternative approach to assessment and treatment that eliminates the medical model and enables the child to access resources for success, emphasising the social context of DCD. Support from educational and clinical psychology may also prove extremely valuable.

Children with significant functional impairment should be identified and referred as early as possible. Early intervention programmes are far more likely to improve these children's coordination and motor skills, which are then more likely to be sustained and, as a direct consequence, these young people (and adults) will show improved self-esteem, socialisation and enjoy more successful and rewarding participation in their community.

This paper has attempted to unravel some of the enigma of DCD (dyspraxia). There is general (if not complete) agreement on the definition of what is a fairly common disorder. It can be recognised by using information available from experienced school staff, a careful physical examination and involvement of physiotherapists and occupational therapists in selected cases. Psychological support is crucial for any associated learning difficulties and if there are secondary behavioural consequences including low self-esteem and social isolation. Various therapies improve motor performance, but it is important that schools provide supportive environments and efforts are made to boost confidence for what could largely be regarded as a social disorder. The real enigma for DCD now is not so much what it is, but what can be done, and which is the best approach, to help these children?

Authors' affiliations

John Gibbs, Department of Paediatrics, Countess of Chester Hospital, Chester, UK
Jeanette Appleton, Neonatal Unit, Wirral NHS Trust (Arrowe Park Hospital), Upton, Wirral, UK
Richard Appleton, The Roald Dahl EEG Department, Paediatric Neurosciences Foundation, Royal Liverpool Children's NHS Trust (Alder Hey), Liverpool, UK

Competing interests: None.

REFERENCES

1 **Bowens A**, Smith I. *Childhood dyspraxia: some issues for the NHS*. Nuffield Portfolio Programme Report No: 2 Leeds, Nuffield Institute for Health, 1999.
2 **Portwood M**. *Developmental dyspraxia: a practical manual for parents and professionals*. Durham: Educational Psychological Service, Durham County Council, 1996.
3 **Kirby A**. Is dyspraxia a medical condition or a social disorder? *Br J Gen Pract* 2004;**54**:6–8.
4 **Polatajko HJ**, Fox AM, Missiuna C. An international consensus on children with developmental coordination disorder. *Can J Occup Ther* 1995;**62**:3–6.
5 **McGovern R**. Developmental dyspraxia: or just plain clumsy? *Early Years* 1991;**12**:37–8.
6 **Gubbay SS**. *The clumsy child: a study of developmental apraxia and agnostic ataxia*. London: WB Saunders, 1975.
7 **Gubbay SS**. The management of developmental apraxia. *Dev Med Child Neurol* 1978;**20**:643–6.
8 **Krutz L**. *How to help a clumsy child. Strategies for young children with developmental motor concerns*. London: Jessica Kingsley, 2003.
9 **Pincus JH**, Glaser GH. The syndrome of ''minimal brain damage'' in childhood. *N Eng J Med* 1966;**275**:27–35.
10 **Rutter M**. Syndromes attributed to ''minimal brain dysfunction'' in childhood. *Am J Psychiatry* 1982;**139**:21–33.
11 **Ayres AJ**. *Sensory integration and the child*. Los Angeles: Western Psychological Services, 1979.
12 **Kadesjo B**, Gillberg C. Developmental coordination disorder in Swedish 7-year-old children *J Am Acad Child Adolesc Psychiatry* 1999;**38**:820–8.
13 **Gillberg C**. Deficits in attention, motor control, and perception: a brief review. *Arch Dis Child* 2003;**88**:904–10.
14 **American Psychiatric Association**. *Diagnostic and statistical manual of mental disorders*, 4th edn, text revision. Washington, DC: American Psychiatric Association, 2000.
15 **Peters JM**, Barnett AL, Henderson SE. Clumsiness, dyspraxia and developmental co-ordination disorder: how do health and educational professionals in the UK define the terms? *Child Care Heath Dev* 2001;**27**:399–412.
16 **Missiuna C**, Polatajko H. Developmental dyspraxia by any other name: are they all just clumsy children? *Am J Occup Ther* 1994;**49**:619–27.
17 **Magalhães LC**, Missiuna C, Wong S. Terminology used in research reports of developmental coordination disorder. *Dev Med Child Neurol* 2006;**48**:937–41.
18 **BBC Health**. *Dyspraxia*, http://www.bbc.co.uk/health/conditions/dyspraxia2 (accessed 9 Jan 2006).
19 **British Association of Community Child Health (Child Development and Disability Group)**. *Standards for child development services: a guide to commissioners and providers*. London: Royal College of Paediatrics and Child Health, 2000.
20 **Gordon N**, McKinlay I. *Helping clumsy children*. Edinburgh: Churchill Livingstone, 1980.
21 **Holsti L**, Grunau RV, Whitfield MF. Developmental coordination disorder in extremely low birth weight children at nine years. *J Dev Behav Pediatr* 2002;**23**:9–15.
22 **Box H**, Bonney H, Greenfield J. The patient's journey: the progressive ataxias. *BMJ* 2005;**331**:1007–9.
23 **Touwen B**. Clinics in Developmental Medicine. *Examination of the child with minor neurological dysfunction, 2nd edn*, No. 71. London: MacKeith Press, 1979.
24 **Denckla MB**. Neurological examination for subtle signs (PANESS). *Psychopharmacol Bull* 1985;**21**:773–800.
25 **Bruininks RH**. *Bruininks-Oseretsky test of motor proficiency examiner's manual*. Circle Pines, Minnesota: American Guidance Service, 1978.
26 **Henderson SE**, Sugden DA. *Movement assessment battery for children*. London: The Psychological Corporation, 1992.
27 **Dunford C**, Street E, O'Connell H, *et al*. Are referrals to occupational therapy for developmental co-ordination disorder appropriate? *Arch Dis Child* 2004;**89**:143–7.
28 **Dunford C**, Richards S. *'Doubly disadvantaged': report of a survey on waiting lists and waiting times for occupational therapy services for children with developmental co-ordination disorder*. London: College of Occupational Therapists, National Association of Paediatric Occupational Therapists, 2003.
29 **McWilliams S**. Developmental co-ordination disorder and self-esteem: do occupational therapy groups have a positive effect? *Br J Occup Ther* 2005;**68**:393–400.
30 **Missiuna C**, Pollock N. Perceived efficacy and goal setting in young children. *Can J Occup Ther* 2000;**67**:101–9.
31 **Missiuna C**, Pollack N, Law M. *Perceived efficacy and goal setting system (PEGS)*. San Antonia TX: Psychological Corporation, 2004.
32 **United Nations**. *United Nations convention on the rights of the child*. Geneva: United Nations, 1989.
33 **Dunford C**, Missiuna C, Street E, Sibert J. Children's perception of the impact of developmental coordination disorder on activities of daily living. *Br J Occup Ther* 2005;**68**:207–14.
34 **Missiuna C**, Pollock N, Law M, *et al*. Examination of a perceived efficacy and goal setting system for young children with disabilities *Am J Occup Ther* 2006;**60**:204–14.
35 **Schoemaker MM**, Flapper B, Verheij NP, *et al*. Evaluation of the developmental coordination disorder questionnaire as a screening instrument. *Dev Med Child Neurol* 2006;**48**:668–73.
36 **Miyahara M**, Möebs I. Developmental dyspraxia and developmental coordination disorder. *Neuropsychol Rev* 1995;**5**:245–68.
37 **Ayres JA**, Mailoux ZK, Wendler CLW. Developmental dyspraxia: is it a unitary function? *Occup Ther J Res* 1987;**7**:93–110.
38 **Laszlo JI**, Sainsbury KM. Perceptual-motor development and prevention of clumsiness. *Psychol Res* 1993;**55**:167–74.
39 **Revie G**, Larkin D. Task-specific intervention with children reduces movement problems. *Adapted Phys Activity Q* 1993;**10**:29–41.
40 **Sims K**, Henderson SE, Morton J, *et al*. The remediation of clumsiness. II. Is kinaesthesis the answer? *Dev Med Child Neurol* 1996;**38**:988–97.
41 **Polatajko HJ**, Macnab JJ, Anstett B, *et al*. A clinical trial of the process-orientated treatment approach for children with developmental co-ordination disorder. *Dev Med Child Neurol* 1995;**37**:310–19.
42 **Sugden DA**, Chambers ME. Intervention in children with developmental coordination disorder: the role of parents and teachers. *Br J Educ Psychol* 2003;**73**:545–61.

43 **Peters JM**, Henderson SE, Dookun D. Provision for children with developmental co-ordination disorder (DCD): audit of the service provider. *Child Care Health Dev* 2004;**30**:463–79.
44 **Rodger S**, Mandich A. Getting the run around: accessing services for children with developmental co-ordination disorder. *Child Care Health Dev* 2005;**31**:449–57.
45 **Coffield M**, O'Neill J. The Durham experience: promoting dyslexia and dyspraxia friendly schools. *Dyslexia* 2004;**10**:253–64.
46 **Hellgren L**, Gillberg IC, Bagenholm A, *et al*. Children with deficits in attention, motor control and perception (DAMP) almost grown up: psychiatric and personality disorders at age 16 years. *J Psychol Psychiatry* 1994;**35**:1255–71.
47 **Rasmussen P**, Gillberg C. Natural outcome of ADHD with developmental coordination disorder at age 22 years: a controlled, longitudinal, community-based study. *J Am Acad Child Adolesc Psychiatry* 2000;**39**:1424–31.
48 **Cermak SA**, Trimble H, Coryell J, *et al*. Bilateral motor coordination in adolescents with and without learning disabilities. *Phys Occup Ther Pediatr* 1990;**10**:5–18.
49 **Losse A**, Henderson S, Elliman D, *et al*. Clumsiness in children— do they grow out of it? A 10-year follow up study. *Dev Med Child Neurol* 1991;**33**:55–68.
50 **Cairney J**, Hay JA, Faught BE, *et al*. Developmental co-ordination disorder, generalized self-efficacy toward physical activity, and participation in organized and free play activities. *J Pediatr* 2005;**147**:515–20.

IMAGES IN PAEDIATRICS

doi: 10.1136/adc.2006.113993

Red fingers syndrome and HIV infection

An 18 month old female, with a history of perinatally acquired HIV infection, treated with estavudine, lamivudine and ritonavir, was CDC immunological category 3 (T CD4+ lymphocytes: 467/µl), clinical category 3 and had a viral load $\log_{10}$ of 5.0. The child presented with painless erythematous lesions, which blanched under pressure, in the periungual and pulp areas of all fingers (fig 1). Skin biopsy showed dilated blood vessels in the upper dermis; no inflammatory cells were detected. Hepatic function was normal and the patient tested serologically negative for hepatitis B and C.

Many mucocutaneous changes and specific skin diseases are associated with HIV infection.[1–3] Distal finger and toe redness is termed red finger syndrome and has been described in adult patients with HIV.[4 5] Some of these patients were co-infected with hepatitis virus, mainly hepatitis C.[5]

Red finger syndrome is rare in children and consists of well-delineated erythema of the periungual and pulp areas, with occasional telangiectasia, on the fingers and/or toes. The lesion is painless with at least a 1 month evolution and the nail plate is normal.[5 6] Histopathological studies have produced non-specific findings on an increased number of dilated blood vessels in the superficial dermis.[5 7] The cause of this finger and toe redness remains unknown. Viral liver diseases and also the high viral load of HIV may play a role.[8]

Vânia Oliveira de Carvalho
Division of Pediatric Dermatology, Universidade Federal do Paraná, Curitiba, Paraná, Brazil
Cristina Rodrigues da Cruz
Division of Pediatric Infectology UFPR, Hospital de Clínicas da UFPR, Curitiba, Paraná, Brazil
Leide Parolin Marinoni
Division of Pediatric Dermatology UFPR, Hospital de Clínicas da UFPR, Curitiba, Paraná, Brazil
Betina Werner
Division of Pathology UFPR, Hospital de Clínicas da UFPR, Curitiba, Paraná, Brazil
Tony Tanous Tahan
Division of Pediatric Infectology UFPR, Hospital de Clínicas da UFPR, Curitiba, Paraná, Brazil
Hermênio Cavalcante Lima
Division of Clinical Immunology UFPR, Hospital de Clínicas da UFPR, Curitiba, Paraná, Brazil

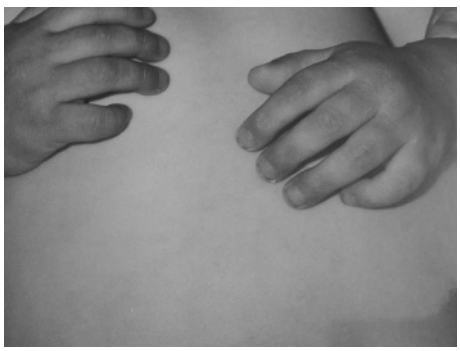

Figure 1 Periungual erythema restricted to the distal parts of the fingers. Parental/guardian informed consent was obtained for publication of this figure.

Correspondence to: Dr Vânia Oliveira de Carvalho, Division of Pediatric Dermatology, Universidade Federal do Paraná, Rua Richard Strauss, 62, Vista Alegre, CEP: 80820-110, Curitiba, Paraná, Brazil; rcarvalho50@hotmail.com

Competing interests: None.

Parental/guardian informed consent was obtained for publication of the person's details in this report.

References

1 **Wananukul S**, Deekajorndech T, Panchareon C, *et al*. Mucocutaneous findings in pediatric AIDS related to degree of immunosuppression. *Pediatr Dermatol* 2003;**20**(4):289–94.
2 **Stefanaki C**, Stratigos AJ, Stratigos JD. Skin manifestations of HIV-1 infection in children. *Clin Dermatol* 2002;**20**(1):74–86.
3 **Smith KJ**, Skelton HG, Yeager J, *et al*. Clinical features of inflammatory dermatoses in human immunodeficiency virus type 1 disease and their correlation with Walter Reed stage. Military Medical Consortium for Applied Retroviral Research. *J Am Acad Dermatol* 1993;**28**(2 Pt 1):167–73.
4 **Cribier B**, Mena ML, Rey D, *et al*. Nail changes in patients infected with human immunodeficiency virus. A prospective controlled study. *Arch Dermatol* 1998;**134**(10):1216–20.
5 **Pechere M**, Krischer J, Rosay A, *et al*. Red fingers syndrome in patients with HIV and hepatitis C infection. *Lancet* 1996;**348**(9021):196–7.
6 **Itin PH**, Gilli L, Nuesch R, *et al*. Erythema of the proximal nailfold in HIV-infected patients. *J Am Acad Dermatol* 1996;**35**(4):631–3.
7 **Osaer F**, Aubin F, Bresson-Hadni S, *et al*. Red fingers syndrome in a HIV-negative woman with hepatitis C cirrhosis. *Br J Dermatol* 1998;**138**(1):193–4.
8 **Doutre MS**, Bernard N, Beylot-Barry M, *et al*. Red fingers syndrome: acrosyndrome related to vascular growth endothelial factor? *Clin Exp Dermatol* 2001;**26**:219–20.